



**Demographic Features of the
Recovering Peregrine Falcon
Population (*Falco peregrinus anatum*)
in Southern Alberta: 1980-1997**

**Wildlife
Management
Division**

**STATUS AND
SURVEYS BRANCH**

David P. Stepnisky



**Alberta Environmental Protection
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Executive Summary

The peregrine falcon (*Falco peregrinus anatum*) was once a common summer resident in southern Alberta, found nesting at cliff sites along all major river systems. At least 60 pairs of peregrines nested in these regions historically (Court 1993b). In the mid-twentieth century, a dramatic decline was seen in the Alberta population. By 1973, no peregrine falcons were breeding successfully in southern Alberta. Pesticides (notably DDT) were the primary cause of this decline (Court 1993a, Court *et al.* 1996). DDT has since been banned for most uses across North America, and peregrine falcon management efforts have assisted in the slow return of the peregrine to southern Alberta. Although management activities have been ongoing since the 1970's, the Southern Alberta Peregrine Falcon Reintroduction Project (1992-1996) has been the most successful of all Alberta peregrine projects undertaken. By 1996, at least 12% of the 223 juvenile peregrine falcons that were released from cliff sites throughout southern Alberta returned as adults (Stepnisky 1996). This surpasses the return rates of all past Alberta release efforts and is well above the 6.2% minimum return rate calculated for falcons released across Canada before 1990 (Holroyd and Banasch 1990).

Peregrine falcon activity has been monitored intensively since the first peregrine falcon was recorded to return to occupy a territory in southern Alberta in 1980. Through band reading, nest site monitoring and surveying, detailed records of peregrine falcon nesting attempts and successes exist; however, these records have never been compiled. In 1998, as managers near a decision on the delisting or downlisting of the peregrine falcon in the United States, and Canadian wildlife managers begin drafting the next step in the Canadian *Anatum* Peregrine National Recovery Plan, it is important to compile and analyse data on peregrine populations.

Although this report does not define the steps that must be taken in future peregrine management, it does present data on the population dynamics of the southern Alberta population and predicts future growth based on these variables. The population of peregrines in southern Alberta has grown from 0 territorial pairs in 1973 to 19 territorial pairs in 1997. Levels of DDE, PCBs, and Dieldrin have all declined over that period. Peregrine falcons have returned to breed in substantial numbers in cities, with nearest nest distances averaging 8 km in urban areas, and 30 km in rural areas. Although there appears to be a preference for these urban habitats, the city nest locations do not appear to be any more productive than rural nest sites. Maximum and minimum estimates of mortality for adult peregrines were determined to be 21% and 28% for adult males and 13% and 14% for adult females. Recruitment rates for falcons fledged from nests in southern Alberta were estimated at 11%. Average productivity (young fledged per territorial pair) for peregrine falcons in southern Alberta from 1981 to 1997 was 1.41 without foster chicks and 2.22 with foster chicks. Because effects of pesticides on peregrine falcon productivity were more prevalent in the 1980's, a more contemporary estimate of productivity would be seen from 1990 to 1997, when the number of young fledged per territorial pair averaged 1.72 without foster chicks and 2.62 with foster chicks. Management activities such as chick fostering have contributed to a significant increase in productivity and population size of peregrine in southern Alberta, as indicated by the high proportions of captive-raised birds in the population.

Predictive modelling is a useful tool in helping managers predict trends in wildlife populations. By using such a model, and inputting various estimates of reproduction and mortality as determined from the southern population between 1981 and 1997, I made predictions of population performance. Assuming that pre-breeding mortality is not excessive (not at the estimated maximum level of 89%), the peregrine falcon population in Alberta should continue to grow in the future, even without management efforts to foster captive-raised young. Nevertheless, fostering young to under-productive wild nests is still an attractive option because the enhanced productivity will speed population growth and raise public awareness of wildlife conservation through these highly visible activities.

Acknowledgments

Peregrine falcon management in southern Alberta has involved so many dedicated individuals over the years that it would be impossible to list everyone. The author would like to acknowledge the following key players who have contributed to the success of the peregrine re-introduction programs in Canada: Richard Fyfe, Harry Armbruster, Ursula Banasch, Geoff Holroyd, Helen Trefry, Phil Trefry, Gary Erickson, Petra Rowell, Ron Bjorge, Dave Moore, Steve Brechtel, Bruce Treichel, Gordon Court, Ken Froggat, Rob Corrigan, and Coral Grove. I would like to thank Petro-Canada, World Wildlife Fund, and the Alberta Sport, Recreation, Parks and Wildlife Foundation for their strong support of the peregrine falcon program in southern Alberta between 1992 and 1996. Additional funds from the Alberta Conservation Association and the Edmonton Natural History Club made possible the data compilation and analysis presented in this report. The Canadian Wildlife Service has also been a key partner in supporting the Wildlife Management Division of Alberta Environmental Protection with the peregrine program.

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1.0 Introduction

The decline of the American peregrine falcon (*Falco peregrinus anatum*) occurred across Canada and the United States during the 1950's and 1960's. Concern for the peregrine's survival resulted in major wildlife management programs aimed at bringing this species back from the brink of extinction (summary in Cade *et al.* 1988).

Organochlorine insecticides (notably DDT) were determined to be the major cause of the decline in peregrine populations (Ratcliffe 1980, Peakall *et al.* 1990). These insecticides, which were used relatively indiscriminately in agriculture, accumulated in peregrine falcon tissues. This bioaccumulation resulted in reproductive failure in the peregrines by causing egg shell thinning and breakage. DDT was banned from most uses in Canada and the United States in 1969 and 1972, respectively. Although an important step in protecting the peregrine from further contamination, the banning of this pesticide was too late for the population in southern Alberta. In 1973, only 3 pairs of peregrine falcons existed in north-eastern Alberta, and no pairs were known to breed in southern Alberta.

As a result of management activities, the population of peregrine falcons in northern Alberta showed slow growth through the 1980's. Throughout the 1970's and 1980's techniques such as fostering and double clutching were useful in increasing productivity. In southern Alberta, the recovery was not as rapid. Before the 1990's, hack releases and some cross-fostering were conducted in Edmonton, near Fort Saskatchewan, Ardley, Rosebud, Black Diamond and Kananaskis in attempts to establish populations (Dekker and Erickson 1986, Nelson 1987). These release efforts saw the return of a few peregrines, but not enough to represent a viable population.

From 1992 to 1996, Alberta Natural Resources Service conducted mass hack releases of peregrine falcons in southern Alberta. This project, the Southern Alberta Peregrine Falcon Reintroduction Project, saw the release of 223 juvenile peregrine falcons, leading to the substantial increase in numbers of breeding falcons in southern Alberta (Stepnisky 1996). By 1996, 15 breeding pairs of falcons resided in southern Alberta, up from 5 pairs when the program began in 1992.

With the completion of the Southern Alberta Peregrine Falcon Reintroduction Project, it is now necessary to re-evaluate the need for continued intensive peregrine falcon management in Alberta. This report reviews the demographics and population dynamics of the peregrine falcon population in southern Alberta, and uses this information, along with predictive population modelling, to evaluate the need for continued management.

2.0 Methods

The population of peregrine falcons in southern Alberta has been monitored since 1981, when one pair was discovered nesting in downtown Edmonton. Between 1981 and 1997, staff of Alberta Natural Resources Service surveyed for peregrine falcon activity each year, and recorded information on egg production, hatching success, and fledging success at active nest sites. In addition, management techniques such as fostering and hack release of captive-raised falcons were employed to bolster the number of falcon chicks entering the wild population. The majority of nest sites in southern Alberta are in urban areas, although cliff sites in rural areas were used by several pairs. Falcon nesting boxes were used by peregrines at several sites.

Falcon chicks were banded at every known nest site in the population. An aluminium US Fish and Wildlife Service band was fitted to one leg, and an aluminium color band (with two or three large alpha-numeric characters) was fitted to the other leg. The color bands were used in order to identify peregrines in future years, without having to capture the adults. Fostered and hack released peregrine falcons were also banded before release.

Infertile, addled, and abandoned peregrine falcon eggs were collected at nest sites in northern and southern Alberta from 1968 to 1997 for pesticide analysis. The egg contents were tested for presence of organochlorine residues (see Court 1993a, Court *et al.* 1996).

Whenever possible, territorial adult falcons were identified. Color bands were readable at distances up to 150 m with a telescope, making it possible to identify banded adult peregrine falcons when they were perched. When unbanded adult peregrine falcons were seen at nest sites, identification was made through photographs or sketches of facial patterns whenever possible (after Nelson 1977).

To estimate population turnover and mortality of adult falcons, methods first described by Mearns and Newton (1984) were used. The basic unit of information was whether a bird identified at any territory in any given year was the same bird that was on that territory the year before. Because of the consistency in identifying falcons in southern Alberta from year to year, this technique was very effective. As described by Court *et al.* (1989), this estimate does not account for those territories that are vacant in subsequent years, thus a second (maximum) estimate of adult mortality was obtained by assuming that a vacancy at a territory was a result of a mortality. Recruitment rates were estimated by determining the number of falcons that fledged from nest sites in southern Alberta and returned as adults, compared to the total number of falcons that fledged. These estimates were used in a predictive model to simulate future dynamics of the population with and without continued management (see Court 1994 for details).

3.0 Results and Discussion

3.1 Pesticides

Residue levels of three of the most-commonly detected organochlorines in abandoned, added, or infertile peregrine falcon eggs, were available for 115 peregrine breeding attempts between 1968 and 1997 (Table 1). When more than one egg was collected from a nest site, the residue levels were averaged to obtain one datum for that nest site. There was a sharp decline in the levels of contaminants in peregrine falcon eggs collected between 1968 and 1997. The geometric mean DDE levels in egg contents for each 5 year period since 1965, declined steadily (Figure 1). In 1997, levels of organochlorine residues were far below the level deemed critical for successful reproduction in peregrines (10 PPM for DDE) (Peakall *et al.* 1990). An equally dramatic increase in the percentage of peregrine eggs that hatched successfully in southern Alberta occurred over the same time period (Figure 1). Predictably, there appears to be a strong correlation between decrease in DDE levels and increased hatching success. This demonstrates that reduction of pesticides in the environment is a major factor in the recovery of the peregrine falcon in southern Alberta.

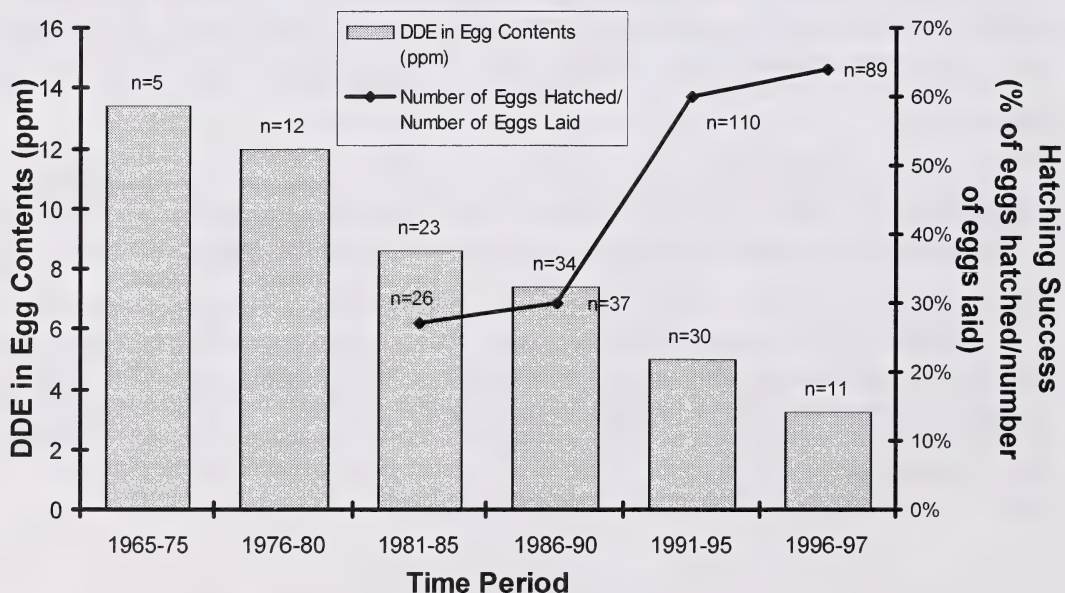


Figure 1. Levels of DDE residues found in peregrine eggs collected from 115 nest sites in Alberta (1965-1997), and eggs (%) hatched from 262 eggs produced at peregrine nest sites in southern Alberta (1981-1997).

Table 1. Levels of organochlorine residues in peregrine falcon eggs from 115 different breeding attempts in Alberta between 1968 and 1997.

Era	n	Geometric Mean Organochlorine Level (ppm)		
		DDE	PCB	Dieldrin
1968-1979	14	11.60 (1.86-63.40)	5.54 (1.87-13.47)	0.43 (0.14-2.34)
1980-1989	55	8.31 (1.51-41.00)	3.95 (1.50-18.00)	0.13 (0.00-1.52)
1990-1997	46	4.90 (0.75-25.69)	1.97 (0.29-9.86)	0.10 (0.00-1.98)

3.2 Nest Sites

3.2.1 Locations of Nest Sites

Peregrines in southern Alberta used nesting habitat as varied as: natural cliffs, bridges, buildings, and falcon nesting boxes. Of the 24 different nesting locations that have been occupied by territorial peregrine falcons in southern Alberta between 1981 to 1997, 7 were in cavities on natural cliffs; 3 were in falcon nest boxes on cliffs; 7 were in falcon nest boxes on buildings; 2 were in falcon nest boxes on bridges; and 5 were on building ledges.

3.2.2 Peregrines in Urban Environments

Throughout North America, peregrine falcons have returned to breed in urban environments (Cade and Bird 1990). The first known pair of peregrine falcons to return to breed in southern Alberta appeared in downtown Edmonton in 1981. All subsequent peregrine nest attempts were located in cities, until 1991, when a pair was located nesting on a cliff in west central Alberta.

Holroyd and Banasch (1990) noted that 91% of the peregrine falcons released across Canada between 1976 and 1987 returned to sites similar to their release sites (urban and rural). This is consistent with peregrines released in urban environments in southern Alberta, but not with peregrines released in rural environments. Of the 17 falcons returning to Alberta from release programs in urban areas of southern Alberta between 1980 and 1997, 16 returned to similar urban sites (94%). Of the 23 falcons returning to Alberta from release programs in rural cliff areas of southern Alberta between 1980 and 1997, only 14 returned to similar rural cliff sites (61%). The remaining 9 falcons (39%) returned to breed in urban areas (see Section 3.3.2 for more detail). This might suggest that peregrine falcons do not show as high a degree of fidelity to sites similar to their fledging areas as once thought, but may in fact show a preference for a certain habitat type that urban environments provide.

It is difficult to explain why peregrine falcons are appearing more frequently in urban environments; however, there are several possibilities. In cities, the probability of detecting a peregrine falcon is far greater than in rural environments. The fact that some falcons breeding in southern Alberta were not banded would indicate that they were produced in nests of unknown location. It is likely that there were several pairs of falcons nesting in the rural areas of southern Alberta, other than the known pairs. Rural pairs are more difficult to detect because there is a lower number of humans living or observing in those areas; hence, there is a lower probability of detection.

Another explanation as to why peregrine falcons are more abundant in urban environments, is that buildings in cities may be 'first class' nesting sites. Hickey (1942) first suggested that certain nest sites may be more attractive to falcons because of their dimensions. Falcons will select these sites year after year because of the physical features. The aerodynamics at these 'first class' nest sites may be very attractive to peregrines because the tall cliffs provide high perches and less energy is required for hunting (Nelson 1987). Tall buildings in cities provide these very high cliff-like characteristics that may be indicative of a 'first class' nest site. If tall buildings are in fact used by peregrine falcons for this reason, it is likely that as these 'first class' nest sites become fully occupied, peregrines in southern Alberta will begin to reoccupy the 'second class' nest sites that were used historically by pairs of peregrines in rural river valleys.

3.2.3 Population Density

Although it is difficult to determine exactly what dictates the territory size of peregrine falcons, food supply and available nesting habitat appear to be limiting factors (Newton 1979, Court 1986). In areas where food supply and nesting habitat are abundant, peregrine populations achieve their highest densities. Populations of peregrine falcons in Canada have been noted in their highest densities in areas where there is good cliff habitat and an abundance of prey (Nelson 1977, Court 1986). Where food is extremely abundant, peregrines will nest as close as 0.4 km apart (Nelson 1977). In southern Alberta, it is difficult to draw any conclusions on population density because the peregrine population it is still recovering. With only 19 active breeding sites, the population of peregrine falcons in southern Alberta in 1997 was far below pre-DDT numbers of at least 60 pairs of falcons (Court 1993b).

To further examine the average densities in southern Alberta, nearest-neighbour distances between peregrine falcon nest sites were calculated. The average nearest-neighbour distance between nest sites in Alberta was 20 km (Table 2), with distances ranging from 3 km to 109 km. By separating the nest sites located in urban areas from nest sites located in rural areas, a considerable difference is seen in peregrine falcon nesting densities. In large cities, the mean nearest-nest distance is 8 km (+/- 8 km), in rural areas, the mean nearest-nest distance is 30 km (+/- 34.2 km). A Student t-Test showed these mean nearest-nest distances to be significantly different ($t=2.24$, $df=13$, $P=0.043$). The greater densities seen in city nest sites can be explained by the theory that peregrines will select the 'first class' nest sites over other inferior sites when nesting. This 'first class' nest site selection has been previously used to explain peregrine densities by Hickey (1942) and for peregrines nesting in Rankin Inlet (Court 1986, see Section 3.2.2. for discussion). It is very possible that in urban areas of southern Alberta, peregrine falcons are nearing a point of maximum densities. If this is correct, peregrine falcons should begin to occupy 'second class' nest sites outside of the cities as more falcons return to breed in the population.

Table 2. Nearest-nest distances for 24 different sites where territorial pairs of falcons were observed in southern Alberta

RURAL		
<i>Nest Site</i>	<i>Closest other Nest Site</i>	<i>Distance Between Sites (km)</i>
Brazeau	Sundance	94
Rosebud	Morrin	40
Ardley	Red Deer River #4	8
Morrin	Red Deer River #1	39
Balzac	University of Calgary	19
Bow City	Rosebud	109
Haynes	Red Deer River #4	4
Wabumun	Sundance	8
Sundance	Wabumun	8
Genesee	Sundance	21
Red Deer River #4	Haynes	4
Red Deer River #5	Haynes	7
Red Deer River #1	Ardley	32
Mean for rural sites:		30

URBAN		
<i>Nest Site</i>	<i>Closest other Nest Site</i>	<i>Distance Between Sites (km)</i>
Edmonton (AGT)	University of Alberta	3
Calgary (Downtown)	University of Calgary	5
University of Alberta	Edmonton (AGT)	3
Inland Cement	Edmonton (AGT)	8
Red Deer (Capri)	Haynes	29
University of Calgary	Calgary (Downtown)	5
Edmonton Beverly	Edmonton (AGT)	9
Edmonton Weber	University of Alberta	4
Ft. Sask (Veridian)	Ft. Sask (Lamoureux)	3
Ft. Sask (Lamoureux)	Ft. Sask (Veridian)	3
Fish Creek	Calgary (Downtown)	13
Mean for urban sites:		8

Mean for all sites:		20
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3.2.4 Effects of Nest Location on Productivity

Urban nesting can be hazardous for peregrine falcons. Although predation is seldom a concern, other non-natural hazards can be significant causes of mortality. Vehicles, electrical wires, and industrial smoke stacks are a few of the many threats to falcons in cities. Given the hazards that are often encountered in cities, one would expect that productivity in urban environments would be less than in rural environments.

Out of 57 breeding attempts (to test the quality of the nest site for production and survival of young, I defined a breeding attempt as a pair of falcons that lay one or more eggs), the productivity of falcons nesting on buildings was 1.53 (+/- 1.59) young fledged per breeding attempt. The productivity of falcons nesting on natural cliffs was 1.89 (+/- 1.71) young fledged per attempt, out of 18 attempts (Table 3). On average it appears that productivity is greater at natural cliff nests, but a Mann-Whitney-U test shows no significant difference in production ($P=0.3886$). This is consistent with Cade and Bird (1990), who found no significant difference in the productivity between 71 urban nest sites and 258 non-urban nest sites.

Peregrine falcon nesting boxes have been used successfully in several cities and on industrial smoke stacks elsewhere (Anderson 1992). More than a dozen nesting boxes have been secured on building sites across southern Alberta. The purpose for securing a box on a building is to prevent loss of eggs or young through poor weather and other hazardous situations. By preventing these losses, the use of falcon boxes should result in higher productivity than would be realised without the boxes. Between 1992 and 1997, nineteen breeding attempts were recorded in these boxes. The number of young produced per breeding attempt averaged 1.79 (+/- 1.55) young. Out of 56 breeding attempts for falcons without nest boxes, the average number of young produced was 1.55 (+/- 1.65). A Mann-Whitney U test showed no significant difference in the number of young produced in these nesting boxes ($P=0.5711$) compared to other sites.

Although evidence suggests that productivity is not affected by nest site location, the thought should not be dismissed entirely. With many nest sites being occupied by inexperienced breeders, and small sample sizes of falcons breeding in the southern Alberta population, it is difficult to draw any solid conclusions. This question should be re-addressed in the future, when the sample size of breeding attempts has increased.

Table 3. A comparison of productivity at peregrine falcon nest sites used between 1981 and 1997 in southern Alberta.

Productivity at building nests vs. cliff nests

	Nests on Buildings	Cliff Nests
<u>Breeding Attempts*</u>	57	18
<u>Successful Breeding Attempts**</u>	32	12
<u>Percentage Successful/Attempt</u>	56%	67%
<u>Number of Young Fledged</u>	87	34
<u>Young Per Attempt</u>	1.53	1.89
<u>Young Per Successful Attempt</u>	2.72	2.83

Productivity with a nest box vs. without a nest box

	Nest Box	No Nest Box
<u>Breeding Attempts*</u>	19	56
<u>Successful Breeding Attempts**</u>	13	32
<u>Percentage Successful/Attempt</u>	68%	57%
<u>Number of Young Fledged</u>	34	87
<u>Young Per Attempt</u>	1.79	1.55
<u>Young Per Successful Attempt</u>	3	2.72

* Any pair of falcons that initiated egg laying at a site was considered to be a breeding attempt.

** Any pair of falcons that fledged naturally produced young was considered to be a successful breeding attempt.

3.3 Movement of peregrines

3.3.1 Migratory Patterns

Anatum peregrine falcons in Alberta are present only during the spring, summer, and fall months. From early late August to mid April (approximately), the individuals in the Alberta populations are elsewhere, having migrated to Central America, South America, and southern portions of North America, where they spend the winter months. Between 1976 and 1997, band recoveries from 7 southern Alberta falcons were documented south of Alberta during winter and fall months (Figure 2). With such a small sample size, it is difficult to draw any solid conclusions about the migration of southern Alberta peregrines; however, these recoveries are consistent with migratory data from other studies (Yates *et al.* 1988). It is interesting to note that peregrine falcons have not been recorded on migration west of the Rocky Mountain range. This general migration pattern approximates waterfowl migration corridors (Bellrose 1968) and is consistent with the theory that peregrines may follow their prey (which consists largely of waterfowl and shorebirds) on migration. This theory is strengthened by reports of peregrine falcons hunting waterfowl and shorebirds at major migratory staging areas (Dekker 1980, Dekker 1987).

3.3.2 Movements From Natal to Breeding Sites

Very little is known about pre-breeding movements of peregrine falcons. In Alberta, hack-released peregrine falcons were found to disperse as far as 147 km north of their birthplace before winter migration (Rowell 1995). This pre-migratory 'wandering' of peregrine falcons has been observed in several situations. This behaviour could possibly be a means through which peregrine falcons search for future nest sites. Besides these few post-fledging movements, very little information has been gathered on pre-breeding movements of peregrines in Alberta, and movements from natal to first breeding sites have never been analysed.

Between 1981 and 1997, 44 territorial adult peregrine falcons, of known origin, were identified as first time breeders at nest sites throughout southern Alberta (Table 4). Both sexes of falcons had similar movements, with an average natal to first site-of-breeding dispersal distance of 206 km (+/-211 km) for females and 216 km (+/- 339 km) for males. The data suggest that there is no difference between males and female dispersal distances (Figure 3), and a Mann-Whitney U test showed no significant difference ($P=0.4547$). This contradicts earlier dispersal estimates for southern Alberta, which were based on a small sample of hack-released birds (Stepnisky 1996). These estimates showed average natal to breeding site dispersal distances to be 169.2 km (+/- 56.2) for females and 90.8 km (+/- 56.7) for males. Mearns and Newton (1984) examined the breeding movements of peregrine falcons in south Scotland, and found that females tend to disperse greater distances from their natal sites than males. Similarly, Holroyd and Banasch (1990) found female peregrine falcons to disperse greater distances from their fledging sites than males. Given these differences, it may be worth the effort to recalculate average dispersal distances for male and female falcons in Southern Alberta after several more years of data collection. It is possible that dispersal distances are abnormally large in this population of falcons, because falcons must travel greater distances from their natal sites in order to find a mate. However, with such a small sample of falcons, it is difficult to draw any solid conclusions.

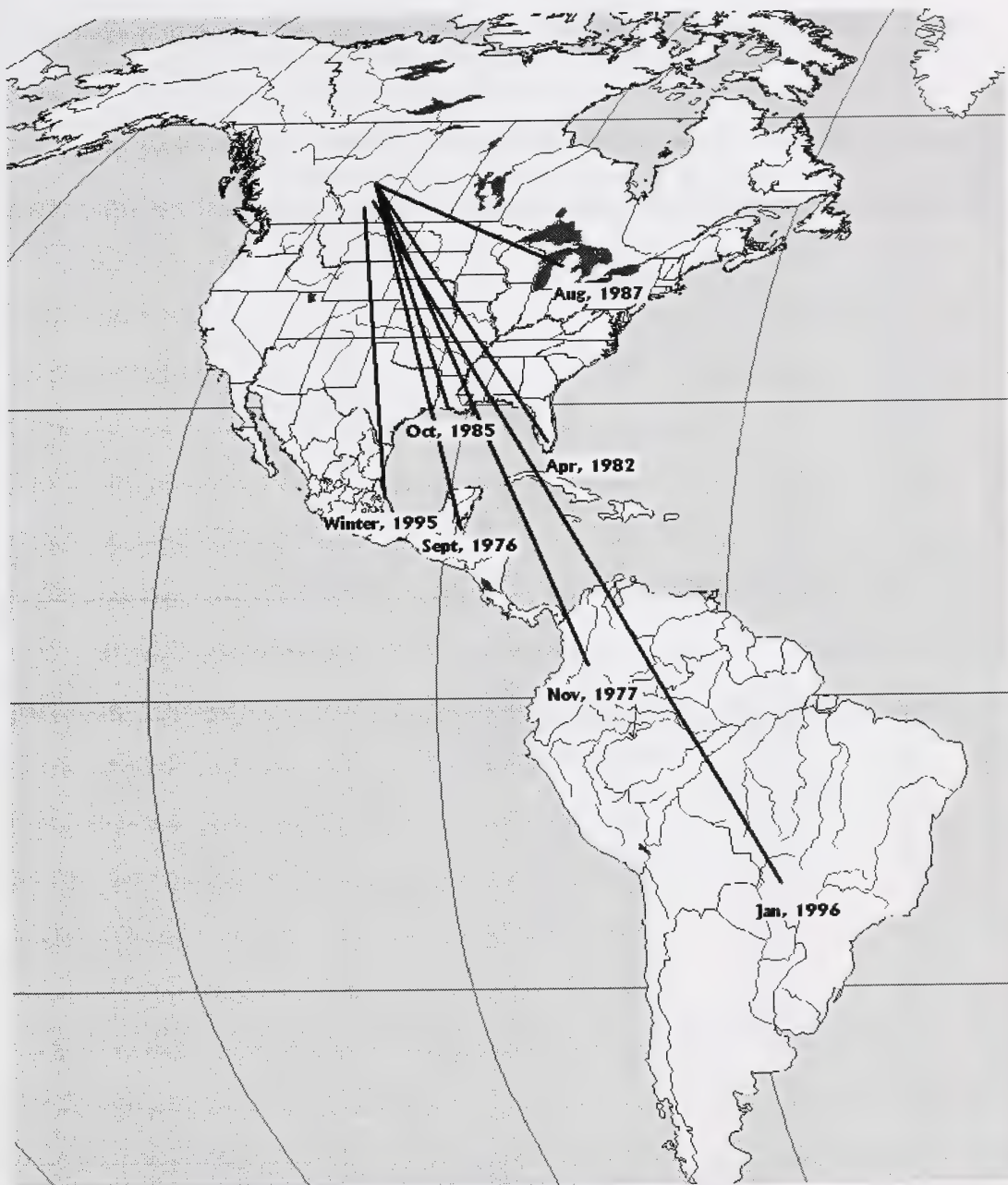


Figure 2. Migratory routes of peregrine falcons from the southern Alberta peregrine falcon population, based on straight-line distances from breeding grounds in Alberta to point of band recovery. The month and year indicate the approximate time of band recovery.

Table 4. Distances between natal or release sites and first breeding sites recorded for peregrine falcons in the southern Alberta population.

Table 4a. Recorded natal (or release) site to first breeding site movements of female peregrines in southern Alberta

<i>Year Banded</i>	<i>Origin (banding location)</i>	<i>Year of 1st breeding attempt</i>	<i>Age at 1st breeding attempt</i>	<i>Breeding Location</i>	<i>Movement*</i>	<i>Distance Dispersed (km)</i>
1980	OS Longman	1982	2	AGT Edmonton	u-u	7
1995	Ardley	1997	2	Silent Springs	c-c	8
1991	AGT Edmonton	1993	2	Inland Cement	u-u	8
1994	U of A	1996	2	Wabumun	u-u	63
1995	Morrin	1997	2	Red Deer R. #5	c-c	74
1996	Haynes hack	1997	1	Morrin	c-c	74
1992	Rosebud	1995	3	U of C	c-u	90
1992	Morrin	1995	3	Balzac	c-u	93
1994	Morrin	1996	2	Fish Creek	c-c	117
1993	U of A	1995	2	Red Deer	u-u	137
1981	Ardley	1983	2	Downtown Calgary	c-u	150
1993	Morrin	1995	2	Beverly	c-u	214
1992	Bow City	1994	2	Ardley	c-c	220
1992	U of A	1994	2	Downtown Calgary	u-u	290
1993	Calgary	1997	4	Ft. Sask. (V)	u-u	306
1992	Saskatoon	1995	3	Downtown Calgary	u-u	525
1977	OS Longman	1979	2	Fraser Bay (N.AB)	u-c	640
1990	Regina	1995	5	AGT Edmonton	u-u	696
<i>Average age at first breeding:</i>			2	<i>Average distance moved:</i>		206

Table 4b. Recorded natal (or release) to first breeding site movements of male peregrines in southern Alberta

<i>Year Banded</i>	<i>Origin (banding location)</i>	<i>Year of 1st breeding attempt</i>	<i>Age at 1st breeding attempt</i>	<i>Breeding Location</i>	<i>Movement*</i>	<i>Distance Dispersed (km)</i>
1992	Bow City	1996	4	Bow City	c-c	0
1993	Morrin	1997	4	Morrin	c-c	0
1994	Ardley	1996	2	Ardley	c-c	0
1986	Downtown Calgary	1987	1	Downtown Calgary	u-u	0
1979	OS Longman	1982	3	AGT Edmonton	u-u	7
1995	Ardley	1997	2	Silent Springs	c-c	8
1993	Morrin	1995	2	Rosebud	c-c	38
1995	Morrin	1997	2	Red Deer R. #1	c-c	39
1995	Morrin	1997	2	Red Deer R. #5	c-c	74
1993	Morrin	1995	2	Red Deer	c-u	89
1994	Morrin	1996	2	U of C	c-u	108
1984	Rosebud	1994	10	Ardley	c-c	113
1993	Ardley	1996	3	Beverly	c-u	146
1992	Bow City	1996	4	Balzac	c-u	152
1994	Ardley	1996	2	Fish Creek	c-c	160
1982	Rosebud	1984	2	AGT Edmonton	c-u	240
1993	U of A	1995	2	U of C	u-u	276
1978	OS Longman	1983	5	AGT Calgary	u-u	290
1988	Downtown Calgary	1989	1	AGT Edmonton	u-u	290
1989	AGT Edmonton	1991	2	Downtown Calgary	u-u	290
1989	Winnipeg	1990	1	AGT Edmonton	u-u	1188
1993	Winnipeg	1997	4	Genessee	u-u	1237
<i>Average age at first breeding:</i>			2.82	<i>Average distance moved:</i>		216

* this indicates the movements from; urban building sites to cliff sites (u-c), cliff sites to urban sites (c-u), cliff sites to cliff sites (c-c), and urban building sites to urban building sites (u-u)

NOTE: For purposes of this analysis, egg-laying was taken as the criterion of breeding by females, and egg-laying by a mate was taken as the criterion for breeding by males.

Of the 40 breeding peregrine falcons of known origin; 14 that originated from cliff sites returned to breed at cliff sites (5 females and 9 males), 16 that originated from urban building sites returned to urban buildings (8 females and 8 males), and 9 falcons that originated from cliff sites moved to urban building sites (4 females and 5 males). Only one falcon was recorded to have moved from an urban building site to a cliff site. Although the concept of ‘first class’ nest sites (as described in Section 3.2.2. of this report) can be used to explain this apparent selection of urban building nest sites, it is difficult to explain why only one bird raised in a urban area has moved to a cliff site to breed.



Figure 3. Dispersal distances between fledging and breeding place based on the identification of 40 adult falcons in southern Alberta with known origins.

3.3.3 Movements of Adults from Breeding Sites to Breeding Sites

High levels of nest site fidelity were noted in the southern Alberta population of peregrine falcons. Out of 23 peregrine falcons (9 females and 14 males) that returned to breed for more than one consecutive year, only 2 females were recorded on different territories. The other 21 falcons all returned to the nesting site where they bred previously. Of the two falcons that moved, one moved 113 km and one moved 8 km. This is consistent with peregrine falcon studies from other parts of the world, which have shown peregrines to be a species that will move considerable distances from birthplace to breeding site, but shows very high levels of nest site fidelity once established on a territory as an adult (Mearns and Newton 1984, Court et al. 1989)

3.4 Peregrine Demographics in Southern Alberta

3.4.1 Population Composition

Between 1979 and 1997, the known population of territorial peregrine falcons in southern Alberta increased from 0 falcons to 19 pairs and one single territorial bird (Figure 4). This increase can be attributed to management through fostering and hack release of captive raised falcons. Figure 5 shows the dramatic effect that management efforts have had on the population; the sharp increase in the number of captive-raised falcons after 1994 is a direct result of the Southern Alberta Peregrine Falcon Reintroduction Project (Stepnisky 1996). In the 1997 breeding season, of 34 territorial peregrine falcons whose banding status was determined, 26 (75%) originated from captive-release projects (hack-releases and fostering). The remaining 8 (24%) were produced at wild nests (Figure 6). Of the 34 falcons identified, at least 4 (12%) were determined to have originated from provinces outside of Alberta. This illustrates that the peregrine falcon population in Alberta is not a closed one; falcons from elsewhere are recruited into the pool of breeding adults. The number of unbanded falcons in the population indicates that there are nest sites that produce young undetected by wildlife biologists. Hence, the actual number of peregrine falcons breeding in Alberta is likely an underestimate.

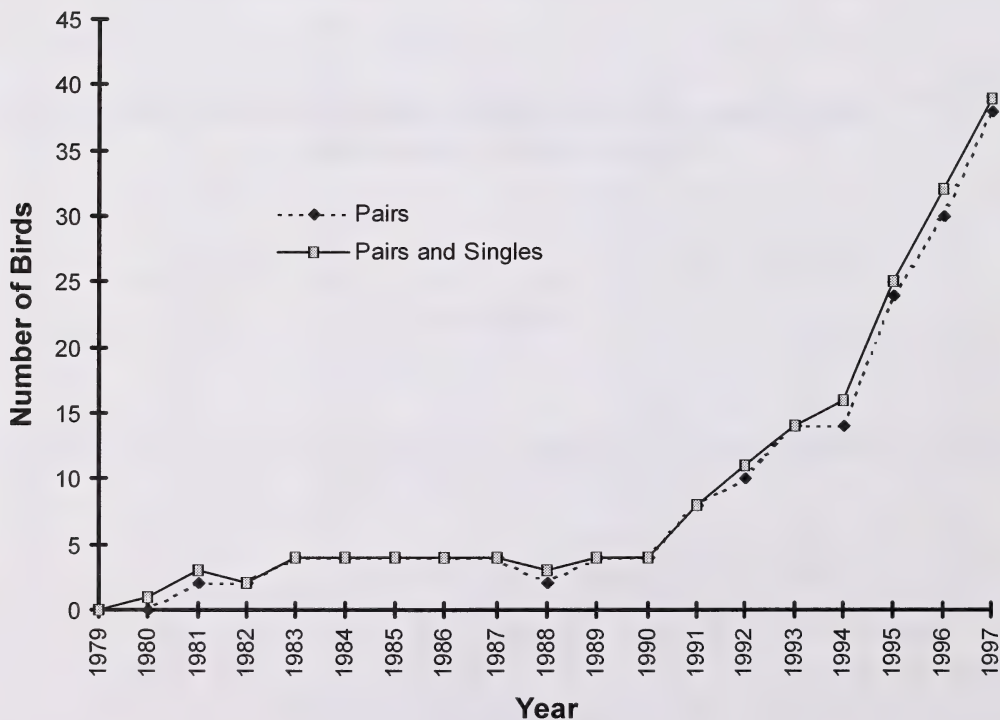


Figure 4. Known peregrine falcon population in southern Alberta, 1979-1997. Only territorial peregrine falcons were recorded as part of the population.

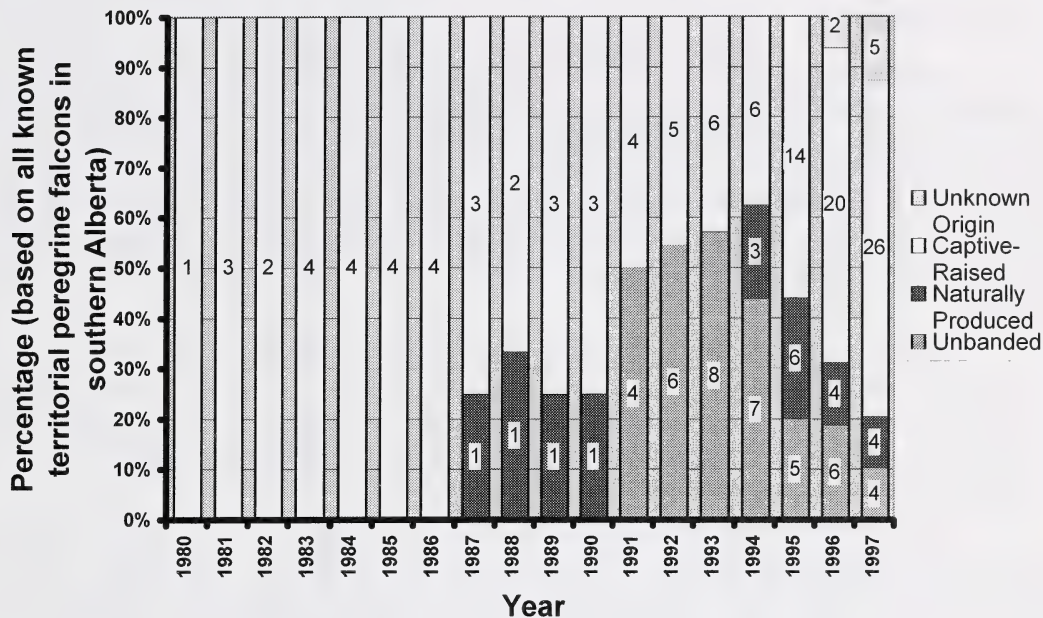


Figure 5. Annual proportions of captive-raised, naturally produced, unbanded, and peregrine falcons of unknown origin on territories in southern Alberta between 1980-1997. Numbers in the bars represent sample sizes.

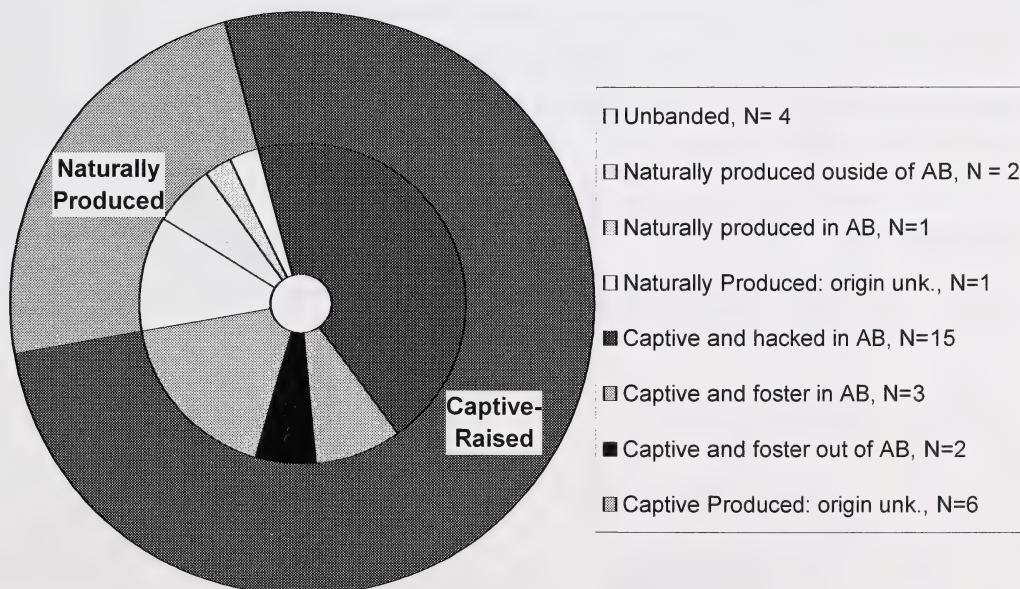


Figure 6. Known origins of territorial peregrine falcons identified in southern Alberta, based on a sample of 34 peregrine falcons identified in 1997

3.4.2 Productivity

Between 1980 and 1997 a total of 86 pairs of falcons and 9 single falcons was recorded on territories in southern Alberta. Of the 86 pairs of birds on territories, 75 (87%) produced a total of 262 eggs, 50 pairs (58% of territories with pairs or 67% of territories with clutches) hatched a total of 141 eggs, and 46 pairs (53% of territories with pairs or 61% of territories with clutches) fledged a total of 121 naturally produced young. In three situations, pairs produced a second clutch after failing. In these situations, only the second clutch (the clutch that hatched young) was included in the total number of eggs counted, as they were produced by the same territorial pair in the same year (Table 5).

Clutches contained 1-5 eggs, with an average of 3.49 eggs per clutch. Of the 262 eggs laid, 141 hatched (54% of the eggs). A total of 121 young fledged from the nest sites between 1980 and 1997, for a mean overall production of 1.27 young fledging per occupied site, 1.61 young fledging per clutch, 1.41 young fledging per territorial pair, and 2.63 young fledging per successful pair (i.e. any pair of falcons that successfully fledged naturally produced young).

As a management activity to increase peregrine falcon productivity in southern Alberta, chicks were often fostered to known nest sites in southern Alberta when natural production was below 4 young. A total of 78 captive-raised young was fostered to nest sites between 1980 and 1997. Seventy of these foster chicks fledged from nest sites. With these additions to wild nest sites, the productivity in southern Alberta averaged 2.22 young per territorial pair between 1980 and 1997. This is considerably greater than the productivity of 1.41 young per territorial pair that would have been realised without fostering.

Natural productivity varied considerably between years; with a minimum of 0.5 young per pair in 1984 and 1989, and a maximum of 2.29 young per pair in 1993. Low productivity was attributed to several factors including poor weather, egg-breakage and addling (in some instances, associated with high pesticide levels), predation of eggs (mostly by avian predators), and mortality of young. Pre-fledging mortality of young in southern Alberta was a result of predation by avian predators and severe weather. Lower levels of productivity were seen in the 1980's, likely because of the persistent effects of pesticides on reproductive output of the falcons. By plotting the productivity (number of young fledged per territorial pair) as five-year averages for the period between 1981 and 1997, we clearly see that production was far lower during the 1980's (Figure 7). An updated estimate for productivity in the post-DDT peregrine population may be obtained with a 1990-1997 average. For the period of 1990-1997 the average productivity was 1.72 young fledging per territorial pair without fostering and 2.62 young fledging per territorial pair with fostering.

Table 5. Population and breeding performance of Peregrines in southern Alberta (1980 -1997).

Year	Number of Territorial pairs	Number of Single birds on territory	Number of birds of eggs laid**	Number of pairs producing eggs	Number of eggs hatched	Number of pairs hatching	Number of young fledged (naturally)	Number of foster young fledged	Number of pairs fledging (naturally)	eggs/ clutch	young fledged/ occupied site (nat.)	young fledged/ clutch (naturally)	young fledged/ pairs fledging (naturally)	young fledged/ terr. pair (naturally)	young fledged/ pair (with fostering)
1980	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-
1981	1	1	0	0	0	0	0	2	0	-	-	-	-	0	2
1982	1	0	3	1	0	0	0	2	0	3	0	0	0	0	2
1983	2	0	7	2	3	1	3	1	1	3.5	1.5	1.5	3	1.5	2
1984	2	0	9	2	1	1	1	1	1	4.5	0.5	0.5	1	0.5	1
1985	2	0	7	2	3	1	3	2	1	3.5	1.5	1.5	3	1.5	2.5
1986	2	0	7	2	4	2	3	0	2	3.5	1.5	1.5	1.5	1.5	1.5
1987	2	0	8	2	1	0	0	3	0	4	0	0	0	0	1.5
1988	1	1	5	1	0	0	0	3	0	5	0	0	0	0	3
1989	2	0	8	2	3	1	1	8	1	4	0.5	0.5	1	0.5	4.5
1990	2	0	9	2	3	1	3	1	1	4.5	1.5	1.5	3	1.50	2.00
1991	4	0	14	4	6	3	5	12	2	3.5	1.25	1.25	2.5	1.25	4.25
1992	5	1	18	5	15	5	15	4	5	3.6	2.5	3	3	3	3.8
1993	7	0	22	6	16	4	16	4	4	3.67	2.29	2.67	4	2.29	2.86
1994	7	2	22	6	16	5	15	8	5	3.67	1.67	2.5	3	2.14	3.29
1995	12	1	34	10	13	5	9	3	3	3.4	0.69	0.9	3	0.75	1
1996*	15	2	44	13	29	10	22	11	10	3.38	1.29	1.69	2.2	1.47	2.20
1997	19	1	45	15	28	11	25	5	10	3.00	1.25	1.67	2.5	1.32	1.58
*Overall:	86	9	262	75	141	50	121	70	46	3.49	1.27	1.61	2.63	1.41	2.22

* These figures Exclude three attempts at re-nesting

** In 1985, 1987, and 1996 pairs of falcons laid more than one clutch. In these cases the number of eggs from the second clutch was counted as the number of eggs laid.

+ In 1996 a malnourished chick was removed from a nest site in southern Alberta for rehabilitation and subsequent release elsewhere. This chick was not counted as a naturally surviving chick, as it would have died from emaciation if left at the nest site.

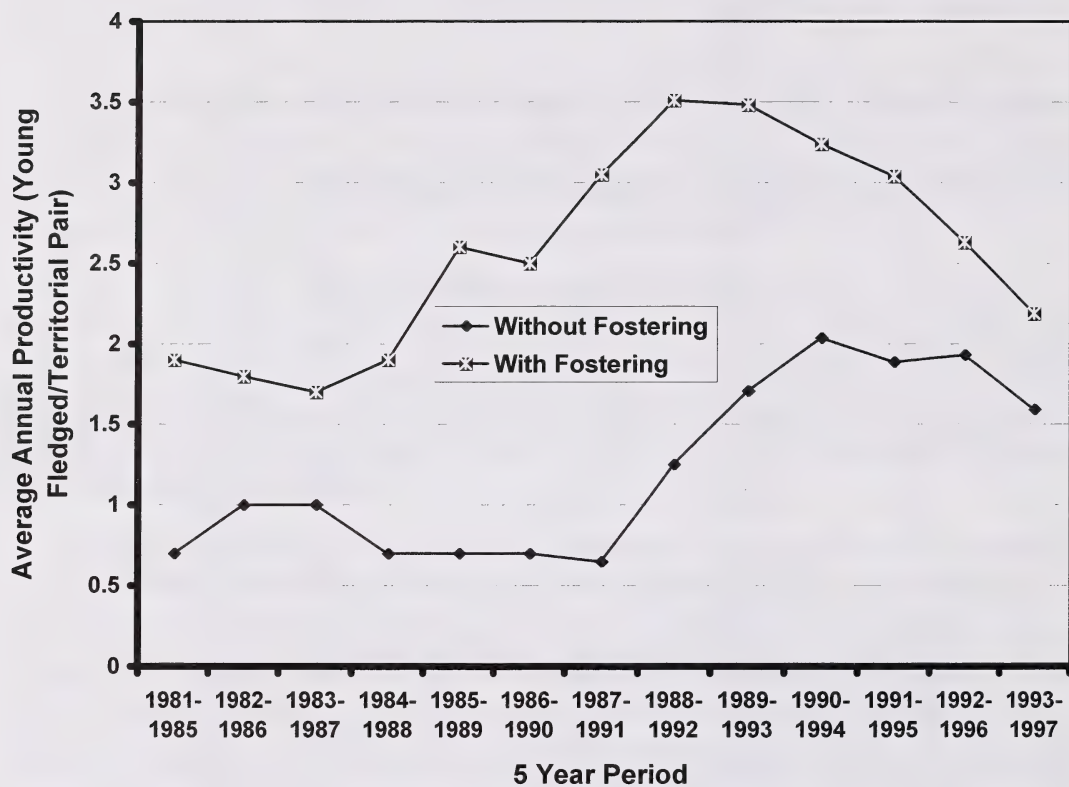


Figure 7. Five year averages of annual productivity (with and without fostering) in southern Alberta for the periods between 1981 and 1997.

3.4.3 Survival of Breeders

Information on adults occupying nesting sites across southern Alberta has been collected consistently through band readings of falcons since 1980. With this information, survivorship of territorial falcons was estimated using the methods described by Mearns and Newton (1984), where one determines whether a bird identified at any territory in a second year was the same bird identified the year before, or a different one. The unit of observation in this analysis is one territory per year, meaning that birds identified for more than 2 years could be included more than once. Because this estimate assumes a bird to be alive in a subsequent year only if it returns and is identified in the study area, it is a minimum estimate of annual mortality.

Adult males were identified in successive years at 43 occasions in southern Alberta; in 32 cases it was the same individual, and in 11 cases a different individual (Table 6a). Two males were recorded having moved to different territories, therefore the annual mortality for breeding adult males was estimated to be 21% (9/43). Females were identified in successive years at 48 territories in southern Alberta; in 39 cases it was the same individual, and in 9 cases it was a different individual (Table 7a). In three situations, females were recorded on different territories, giving an estimate of annual mortality for breeding females of 13% (6/48). Minimum annual mortality for both sexes combined was 16% (15/91).

This estimate of adult mortality is a conservative one, as territorial vacancies following years of occupancy (as occasionally seen in the southern Alberta population) are not included in the analysis. Court *et al.* (1989) altered the methodology to achieve a second estimate of mortality (maximum annual mortality) where vacancy at a territory in a year succeeding identification was considered a mortality. Based on this methodology, a maximum estimate of annual mortality was calculated for southern Alberta to be 28% (13/47) for male falcons (Table 6b) and 14% (7/49) for female falcons (Table 7b). Annual maximum mortality for both sexes combined was 21% (20/96).

The minimum annual mortality of 16% for breeding peregrines in southern Alberta is consistent with estimates obtained in similar studies. In northern Alberta, Court (1994) calculated the minimum average annual mortality to be 16%; Mearns and Newton (1984) estimated the annual mortality for peregrines in south Scotland to be 11%; and Court *et al.* (1989) estimated the minimum annual mortality to be 17% for a population of falcons in Arctic Canada. Similarly, the maximum estimates of annual mortality of 21% for breeding peregrines in southern Alberta is consistent with estimates obtained by Court *et al.* (1989), who estimated the maximum average mortality to be 24% for a population of peregrines in Arctic Canada.

The values obtained for annual mortality of breeding males and female peregrines in southern Alberta are under estimates. These estimates of mortality assume a closed population of peregrine falcons in southern Alberta. They do not take into account those known or unknown nest sites where peregrine falcons could not be identified by band reading. Small sample sizes and methods used to determine mortality result in biases, in that long-lived birds (such as a female falcon that was recorded at a nest site for 12 consecutive years) will strongly influence the estimate of survivorship. Although these are biased estimates, they give some indication that the mortality in southern Alberta is not inordinately high and can be used in simulating the population's dynamics.

Table 6a. Minimum estimate of turnover and loss of male peregrine falcons from the southern Alberta population.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
<i>Identified on territories where identification was possible in the next or later year</i>	1	2	1	2	2	2	2	1	1	2	2	2	2	2	4	7	8	43
<i>Identified on the same territory in the next or later year</i>	1	2	1	1	2	2	1	1	1	1	1	2	2	2	2	4	6	32
<i>Identified on a different territory in the next or later year</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
<i>Total Identified</i>	1	2	1	1	2	2	1	1	1	1	1	2	2	2	3	4	7	34
<i>Maximum loss</i>	0	0	0	1	0	0	1	0	0	1	1	0	0	0	1	3	1	9
<i>Percent loss</i>	0%	0%	0%	50%	0%	0%	50%	0%	0%	50%	50%	0%	0%	0%	25%	43%	13%	21%

Table 6b. Maximum estimate of turnover and loss of male peregrine falcons from the southern Alberta population.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
<i>Identified on territories where identification was possible in the next or later year</i>	1	2	1	2	2	2	2	2	1	2	2	2	2	2	4	8	10	47
<i>Identified on the same territory in the next or later year</i>	1	2	1	1	2	2	1	1	1	1	1	2	2	2	2	4	6	32
<i>Identified on a different territory in the next or later year</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
<i>Total Identified</i>	1	2	1	1	2	2	1	1	1	1	1	2	2	2	3	4	7	34
<i>Maximum loss</i>	0	0	0	1	0	0	1	1	0	1	1	0	0	0	1	4	3	13
<i>Percent loss</i>	0%	0%	0%	50%	0%	0%	50%	50%	0%	50%	50%	0%	0%	0%	25%	50%	30%	28%

Table 7a. Minimum estimate of turnover and loss of female peregrine falcons from the southern Alberta population.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
<i>Identified on territories where identification was possible in the next or later year</i>	1	1	2	2	2	2	2	2	2	2	3	3	4	4	8	8	48
<i>Identified on the same territory in the next or later year</i>	1	1	2	2	2	2	2	2	2	2	3	2	3	2	5	6	39
<i>Identified on a different territory in the next or later year</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
<i>Total Identified</i>	1	1	2	2	2	2	2	2	2	2	3	2	3	3	6	7	42
<i>Maximum loss</i>	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	1	6
<i>Percent loss</i>	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	25%	25%	25%	13%	13%

Table 7b. Maximum estimate of turnover and loss of female peregrine falcons from the southern Alberta population.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
<i>Identified on territories where identification was possible in the next or later year</i>	1	1	2	2	2	2	2	2	2	2	3	3	4	4	8	9	49
<i>Identified on the same territory in the next or later year</i>	1	1	2	2	2	2	2	2	2	2	3	2	3	2	5	6	39
<i>Identified on a different territory in the next or later year</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
<i>Total Identified</i>	1	1	2	2	2	2	2	2	2	2	3	2	3	3	6	7	42
<i>Maximum loss</i>	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	7
<i>Percent loss</i>	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	25%	25%	25%	22%	14%

3.4.4 Survival of Pre-breeders

Limited information exists on peregrine falcons between fledging age and the time of breeding in southern Alberta. Like other study populations of peregrine falcons, the location of pre-breeding birds is rarely determined and thus pre-breeding mortality is difficult to calculate (Newton and Mearns 1988, Court 1994).

The recruitment rate of peregrine falcons is the best estimate for pre-breeding survival that exists in southern Alberta. The recruitment rate was calculated as the number of young that returned to territories in southern Alberta, compared to the total number of young that fledged from nest sites. It is important to note that only falcons that fledged from wild nests (both foster and wild chicks) were included in this analysis. Falcons that returned from hack-release projects were not included. Out of 161 young to have fledged from nest sites in southern Alberta between 1980 and 1995 (1996 and 1997 were not included in the calculation, as the young have not had sufficient time to return as mature adults), 18 (11%) falcons have returned as adults on territories. In other words, for every 9 young that fledged from nest sites in southern Alberta, one breeder recruited into the population.

The 11% recruitment rate is constant with other estimates for recovering populations of peregrine falcons in Alberta. Stepnisky (1996) estimated return rates (the number of released falcons out of the total number of released falcons that have been observed in years subsequent to their release) of hack-released peregrine falcons in southern Alberta to be 12%, and Court (1994) estimated recruitment rates of 8% for peregrine falcons in northern Alberta.

3.4.5 Age of First Breeding

Egg laying was taken as the criterion of breeding by females, and egg-laying by a mate was taken as the criterion for breeding by males. This eliminated the counting of any immature falcons (one-year-old birds) that appeared on territories with an adult and were observed to beg from the older falcon, but showed no attempt to breed. Of 22 male falcons identified as first-time breeders; 3 were breeding at age 1, 11 at age 2, 2 at age 3, 4 at age 4, 1 at age 5, and 1 at age 10. Of 18 females identified as first-time breeders; 1 was breeding at age 1, 12 at age 2, 3 at age 3, 1 at age 4, and 1 at age 5 (Table 4). Based on this information, the average age for a first-time breeding for males was 2.8 (+/- 1.9 years) and 2.4 years (+/- 0.9 years) for females. A paired t-test showed no significant difference between the first-time breeding age for males and females ($df=31$, $t=-0.92$, $P=0.37$). Newton and Mearns (1988) showed similar ages for first breeding, with an average age for females of 2 years and 2.5 years for males.

Although few one-year-old falcons produced eggs, there were large numbers of one-year-old peregrines attempting to breed. This suggests that the population of falcons in southern Alberta is still recovering. Stable populations of peregrine falcons rarely have any one-year-old birds on territories. In a stable population, the available nest sites will be taken by older, more experienced birds. Such conjecture was offered to explain similar observations in Scottish birds (Mearns and Newton 1984). In southern Alberta, only a small percentage of the historical nest sites are occupied by peregrines. Hence, young falcons are rarely, if ever, required to defend their territories against older birds. In the future, if all nesting sites become occupied, fewer immature birds are likely to be seen breeding, as they will be required to compete for nest sites with older, more experienced falcons.

3.5 Predicting the Future of the Peregrine in Southern Alberta Through Population Modelling

In order to make predictions on the future population growth of the peregrine falcon population in southern Alberta, a deterministic model was used (Schneider, 1994). The size of the population is calculated in subsequent years by adding recruitment to the size of the population in the previous year minus annual mortality. The model predicts an exponential growth or decline, as there is no density-dependent feedback on either reproduction or mortality, and immigration is assumed to equal emigration. At small population sizes, the effects of demographic and environmental stochasticity influence population trajectories as much as the intrinsic rate of growth. With the small population size of peregrine falcons in Alberta, it was necessary to perform 100 repetitions on each simulation in order to obtain stable estimates of growth rates. For this reason, no actual future population numbers are predicted in this analysis and growth rates are presented as either positive or negative.

Several simulations of population maintenance were run in order to incorporate different mortality estimates with and without continued management (through fostering of chicks). Simulations were run with set parameters of 60 nest sites being available in southern Alberta every year (based on historic nesting records compiled by Court 1993b) and the average age of first breeding being 2 years (a rounded number obtained from Section 3.4.5.).

Two series of simulations were run, based on minimum (21% for males and 13% for females) and maximum (28% for males and 14% for females) estimates of adult annual mortality, calculated in an earlier section of this report (section 3.4.3). The simulations also used 25 pairs of falcons as an initial population size. Although the population size in 1997 is only 19 pairs, I added six more pairs of falcons that will likely appear to breed in southern Alberta, as a result of the continuing return of peregrine falcons released in the Southern Alberta Peregrine Falcon Reintroduction Project, based on current levels of recruitment (Stepnisky 1996).

Three estimates of pre-breeding mortality were used in the simulations. The first estimate was based on the recruitment rate (11%) calculated in an earlier portion of this report (section 3.4.4). This maximum pre-breeding mortality estimate of 89% is a conservative one, as it assumes that all birds that were not detected in a year subsequent to their fledging died. A second estimate was based on dispersal data collected from the Southern Alberta Peregrine Falcon Reintroduction Program (Stepnisky 1996). Peregrine falcons in the Reintroduction Program were observed on a daily basis, until they were recorded to disperse from the release sites. This provides an opportunity to determine the survivorship of young until the dispersal age, which could not be done in the peregrine falcon natural eyries because of limitations in resources to conduct consistent nest-site observations. From this information a minimum estimate of mortality of 31% was obtained by assuming that every falcon that successfully dispersed from the release site would survive to an age of breeding (see Stepnisky 1996 for details). A third estimate of 66% was used as an average pre-breeding mortality rate. This mortality rate was taken from an estimate derived by Court (1994), who used several references of pre-breeding mortality to come up with a mid-range estimate.

In order to determine the effects of management on future population dynamics, two different levels of population productivity were used. The average productivity of 1.72 falcons per pair was used to model population dynamics without future management; 1.72 young per pair being the average natural productivity for falcons in southern Alberta between 1990 and 1997. The average productivity of 2.62 was used to model population dynamics with future management; 2.62 young per pair being the average productivity with fostering for falcons in southern Alberta between 1990 and 1997 (see Section 3.4.2 for discussion).

The results of this predictive modelling are encouraging. Based on the defined parameters, the peregrine falcon population in southern Alberta should show positive growth in the future, unless pre-breeding mortality is very high (Table 8). If pre-breeding mortality is at a maximum (88%), fostering will possibly prevent a further decline in the population.

Predictive models are simply tools to help managers with decision making. It is important to realise that this model is only a prediction of what may happen in the future, based on the present data available for peregrine falcons in southern Alberta. One may conclude that it is important to continue fostering of captive-raised peregrine falcons in the future in order to avoid this potential decline, especially in the event that major pre-breeding mortality occurs. Evidence from other recovering populations around the world, however suggests that this is unlikely (Cade *et. al.* 1988). In several populations of peregrine falcons, where management efforts have not relied on introduced captive-raised falcons, numbers doubled every 6-7 years toward saturation. There is no biological evidence that suggests the population in Alberta will not continue to grow without management activities, now that there is a sufficient number of breeders in the population.

Table 8a. Results of predictive models based on minimum estimates of adult mortality, varying pre-breeding mortality estimates, and both supplemental and natural productivity for peregrine falcons nesting in southern Alberta.

	Assuming Maximum pre-breeding mortality (89%)	Assuming Moderate pre-breeding mortality (66%)	Assuming Minimum pre-breeding mortality (31%)
Supplemented Productivity (continuing to foster) 2.62 young/pair	Positive Population Growth	Positive Population Growth	Positive Population Growth
Average Natural Productivity (no future management) 1.72 young/pair	Negative Population Growth	Positive Population Growth	Positive Population Growth

Table 8b. Results of predictive models based on maximum estimates of adult mortality, varying pre-breeding mortality estimates, and both supplemental and natural productivity for peregrine falcons nesting in southern Alberta.

	Assuming Maximum pre-breeding mortality (89%)	Assuming Moderate pre-breeding mortality (66%)	Assuming Minimum pre-breeding mortality (31%)
Supplemented Productivity (continuing to foster) 2.62 young/pair	Negative Population Growth	Positive Population Growth	Positive Population Growth
Average Natural Productivity (no future management) 1.72 young/pair	Negative Population Growth	Positive Population Growth	Positive Population Growth

4.0 Conclusions and Recommendations

Evidence shows that the peregrine falcon population in southern Alberta is undergoing a recovery. An increase in the number of active nest sites over the past decade indicates that the population is growing. Decreasing levels of organochlorine pesticides and a greater proportion of breeding adults in the population are a few of the many factors that point to a healthier population. Predictive modelling suggests that the southern Alberta population of peregrine will continue to grow, assuming that pre-breeding and adult mortality do not become excessive. If high mortalities are seen in the future, fostering may be a management tool to sustain the population.

Over the past twenty years, several hundred thousand of dollars, countless hours of work, and support by several government and corporate agencies have been invested in peregrine management in southern Alberta. It would be unwise to discontinue management efforts at this time. To ensure the continued growth of the southern Alberta population of peregrine falcons, I strongly recommend that efforts continue to focus on population monitoring. Future activities should include:

- Monitoring nest sites (gathering information reproductive success)
- Monitoring pesticide levels in unhatched eggs
- Banding all known chicks at nest sites
- Monitoring survival of adults (through band reading)
- Surveying of historic peregrine nest sites for new territorial pairs
- Annual compilation of sites, pairs, productivity, banding efforts, and recoveries in a report

Fostering may be used to speed the future growth of the peregrine population by ensuring high levels of productivity, but will be equally, if not more important as a tool for public education on wildlife management issues. Fostering should be encouraged as it will also continue to assist in the preservation of valuable genetic stock of *anatum* peregrine falcons by supporting captive breeding programs which contain peregrine bloodlines dating back to the pre-DDT era in Alberta.

The most important task of managers over the next decade will be watch the population of falcons in Alberta, to ensure that the predicted growth and recovery continues into the 21st century.

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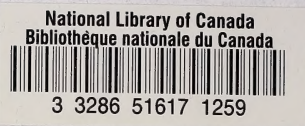
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